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in the name of Nütromaschinen- und Anlagenbau GmbH, Co. KG, Leonie 5, 91275 Auerbach/Oberpfalz, Germany.

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Water-Vapour Assisted Lacquering Method

The present invention relates to a method for coating substrates in accordance with the generic term of claim 1 and a corresponding system in accordance with the generic term of claim 7.

Many objects in daily use, miscellaneous consumer goods as well as objects used commercially or industrially derive their external appearance only through the agency of a coating, said coating capable of being used both for aesthetic reasons and to provide a protective function. A widespread coating possibility is afforded by coating methods in which a film, the so-called paint, which adheres on, protects and, perhaps, decorates a substrate is generated with the aid of a coating material based on an organic binder. Such a coating material contains pigments, fillers, additives and/or solvents or dispersing agents in addition to macromolecular film-forming agents or film-forming agents that form macromolecules. By solvents here is meant all liquids or liquid mixtures, such as alcohols and water, that are capable of dissolving the film-forming agent(s). By dispersing agent is meant those liquids such as hydrocarbons and water which, although they do not dissolve the film-forming agent, keep it in a fine, micro-heterogeneous distribution .

Such coating materials, which may generally be termed paints, may be applied to the objects or substrates for coating by the most diverse methods. Examples of these are dip coating, painting and spraying.

Especially, spraying techniques are of major importance in industrial use because they facilitate automated and industrial production featuring particularly uniform paint formation. In spraying methods, the coating material to be applied to the substrate is atomised by different methods into a plurality of small droplets which are then deposited uniformly on the substrate where they coalesce again to form a film. An example of a known atomisation method consists in driving the coating material through an arrangement of nozzles, after which, having left the nozzle, it is shredded into many small droplets. In this connection, either the coating material itself is forced under corresponding pressure through the nozzle arrangement (hydraulic) or the coating material is atomised by means of compressed air

(pneumatic), with the compressed air exiting the nozzle arrangement together with the coating material.

The present invention relates to the application of paints to substrates by means of spraying methods in which the coating material is atomised by a nozzle arrangement, such as a paint gun.

The problem with these known methods, especially as regards the application of water-based paints in which water serves as the solvent or dispersing agent, is that air occlusions in the case of pneumatic atomisation prevent a homogeneous coating from being achieved on the substrate surface. Especially in the case of substrates with a high surface tension, such as plastics, islands with an absence of coating material occur in the paint film on the substrate. This is especially problematic if the coating consists of several layers and islands form already in the base coat or prime coat since these then are propagated in the subsequent layers. Island formation is observed especially when plastics are coated with so-called adhesion promoters (primers) having a very high water content and a low solids content.

It is therefore the object of the present invention to provide a method for applying paints to substrates that avoids the problem of island formation during paint application. At the same time, this method is to be simple and economical to use, without the need for major changes to existing painting equipment.

This object is achieved by means of a method having the features of claim 1 and a system for coating substrates having the features of claim 7. Advantageous embodiments are the object of the dependent claims.

With the present invention it was surprisingly found that the aforementioned problems of island formation, especially during application of water-based paints to plastics, can be simply avoided by using water vapour as the auxiliary gas during pneumatic atomisation instead of air. This avoids the air occlusions in the paint and the resultant formation of islands in the paint layer. Moreover, this method is easy to realise since only water vapour need be used instead of the air, with the result that existing machinery can largely continue to be used. All that is needed is for certain water-vapour feed lines or seals to be appropriately designed such that they can permanently withstand water-vapour. Ceramic seals in the paint guns, for

example, lend themselves to this. From a machinery point of view, it is only necessary to provide an additional device to generate water vapour.

Preferably, the water vapour may be used in the low pressure range of 0.5 to 2 bar or in the high pressure range from 2 to 10, especially 4 to 8 bar.

Aside from water-based paints in which water is the solvent or dispersing agent, the use of water vapour also as an auxiliary gas for pneumatic spraying of essentially solvent-free hot melt paint has proven itself since, in the case of these paints, which consist almost of 100 percent solids, the heated water-vapour does not effect cooling of the melted paint during spraying, or even additional heating or warming of the melt paint for liquefaction can be dispensed with.

Aside from the use of the method of the invention for the application of, especially, primers to plastics, it goes without saying that this method can naturally be used for corresponding top coats, filler layers or clearcoat layers on metals or wood materials as well.

Preferably, a device for avoiding water droplets in the water vapour is provided close to the nozzle opening in the spray gun. This may be formed by a pressure-increasing device and/or a heating device. The arrangement is to be chosen such that virtually pure water vapour is available at the nozzle opening. Correspondingly, the length of the heating device or its rating/performance must be chosen such that an adequate temperature increase is attained. The same applies to the pressure-increasing device with regard to the change in pressure.

Further advantages, characteristics and features of the present invention are apparent from the following detailed description of an embodiment using the enclosed drawings. The purely schematic drawings show in

Fig. 1 a) and b) a schematic diagram of nozzle arrangements with internal mixing (a) and external mixing (b) of the coating material with the water vapour used as auxiliary gas for application;

Fig. 2 a schematic diagram of a system for coating substrates in accordance with the present invention;

Fig. 3 a schematic diagram of the water-vapour feed line in the spray gun; and in

Fig. 4 a schematic diagram of a second embodiment of the water-vapour feed line in the spray gun.

Fig. 1 shows in two schematic diagrams two different nozzle arrangements 1, which, for example, can be realised in a spray gun in order that the method of the invention may be performed.

In the nozzle arrangement 1 of sub-diagram a), the nozzle arrangement has an inner nozzle 2 and an outer nozzle 3, with the nozzle opening 4 of the inner nozzle 2 arranged inside the outer nozzle arrangement 3 directly in front of the nozzle opening 5 of the outer nozzle arrangement 3. In this way, the coating material transported in the internal nozzle arrangement 2 is mixed with the water vapour transported in the outer nozzle arrangement 3 prior to finally leaving the nozzle arrangement 1 through the nozzle opening 5 of the outer nozzle arrangement 3 (internal mixing).

As opposed to this, in the nozzle arrangement 1 of sub-diagram b), in which the nozzle opening 4 of the inner nozzle arrangement 2 is arranged at the same level as the nozzle opening 5 of the outer nozzle arrangement 3, mixing of the coating material located in the inner nozzle arrangement 2 with the water vapour, which has left the outer nozzle arrangement 3 through the nozzle opening 5, occurs only after said coating material has left nozzle arrangement 1 (external mixing).

These two types of spray coating of the coating material with the aid of water vapour can be used for the present invention.

Fig. 2 is a purely schematic drawing of a system for coating substrates in accordance with the present invention, wherein a spray gun 1 is connected in accordance with the nozzle arrangements of Fig. 1 via a first feed line 6 to a first supply device 8 for providing and feeding the coating material to the spray gun 1, with the coating material being conveyed in the feed line 6 by a pump 10.

The spray gun 1 is further connected via a second feed line 7 to a second supply device 9, which comprises a water-vapour generator, by means of which the water vapour required for the invention can be generated and conveyed to the spray gun 1.

As part of the second supply device 9 or, as shown in Fig. 2, as a separate device, a pressure-increasing or compression device, such as a pump 11, may be provided in the second line 7 to bring the water vapour to the corresponding operating pressure range of 0.5 to 10 bar or 1 to 2 or 4 to 8 bar.

In the same way, it goes without saying that the corresponding pressure-increasing or compression device 10 may also be integrated in the first supply device for the coating material or be provided separately in the first supply line 6 (as illustrated).

It goes without saying that the pump 10 in the supply line 6 for the coating material can also be dispensed with if the suction of the water vapour ensures adequate transport of the coating material.

Figs. 3 and 4 schematically show the preferred embodiments of the spray gun 1 and the water-vapour feed line 7.

In accordance with Fig. 3, the cross-section of the feed line is reduced in the vicinity of the delivery opening or nozzle opening 5 such that the pressure directly in front of the nozzle opening 5 increases, so that even the tiniest quantities of water droplets, which may have precipitated out of the water vapour, are vaporised again and thus almost pure water vapour is available for application of the coating material. In the embodiment shown in Fig. 3, this is achieved by a conical region 13 in the feed line 7, said conical region reducing the first cross-section of the line 7 in region 12 to a second cross-section in region 14.

Fig. 4 shows a further possibility for counteracting the formation of water droplets in the water vapour. For this purpose, an additional heating device 15 is provided directly in front of or at the nozzle opening 5, by means of which said device the water vapour can be correspondingly heated and superheated such that all of the water is present in water vapour form. All known devices, such as electrical resistance heaters with windings around line 7 or

cartridge heaters with exothermic materials or fuels for use in a cavity of the spray gun, can serve as the heating device 15.

Patent claims

1. Method for coating substrates with at least one coating material, which comprises at least one organic component, wherein the coating material is applied to the substrate by atomisation and spraying, wherein the coating material is atomised by water vapour.

2. Method in accordance with claim 1, wherein the coating material is a water-based paint or an essentially solvent-free hot melt paint.

3. Method in accordance with claims 1 or 2, wherein the coating material is applied as primer, top coat, filler or clearcoat.

4. Method in accordance with any of the previous claims, wherein the coating material, by flowing through a nozzle arrangement, especially a spray gun, is atomised with the water vapour acting as auxiliary gas and is sprayed onto the substrate.

5. Method in accordance with any of the previous claims, wherein the water vapour, flows out of a nozzle arrangement with (internal mixing) or adjacent (external mixing) to the coating material, especially concentric to the coating material, with the water vapour of the nozzle arrangement being fed at a pressure of 0.5 to 10 bar, especially 0.5 to 1 bar or 4 to 8 bar.

6. Method in accordance with any of the previous claims, wherein metals, plastics or wood materials may be used as substrate.

7. System for coating substrates, especially for performing the method in accordance with any of the previous claims, with at least one nozzle arrangement (1) for atomising and spraying a coating material onto a substrate and at least a first supply device (8) for providing and feeding the coating material to the nozzle arrangement (1) and at least a second supply device (9) for preparing and feeding an auxiliary gas to the nozzle arrangement (1) for atomising the coating material, wherein the second supply device (9) comprises a water-vapour generator.

8. System in accordance with claim 7, wherein the second supply device (9) and/or the feed line (7) to the nozzle arrangement (1) comprises a pressure-increasing or compression device (11), with which the water vapour can be brought to operating pressure in the range of 0.5 to 10 bar, especially 1 to 2 or 4 to 8 bar.

9. System in accordance with claims 7 or 8, wherein that the spray gun (1) has a heating device (15) and/or a pressure-increasing device (13) for converting nearly all of the water into the vapour phase, preferably in the immediate vicinity of the nozzle opening (5).

10. System in accordance with any of the previous claims, wherein the pressure-increasing device is formed by a reduction in cross-section (13) of the feed line (7).

SUMMARY

The invention relates to a method or a system for coating substrates with at least one coating material which comprises at least one organic component, wherein the coating material is applied to the substrate by means of atomisation and spray-painting. The invention is characterised in that the coating material is atomised by means of water vapour.

The invention also relates to a system for coating substrates, wherein at least one nozzle arrangement (1) is provided in order to atomise and spray the coating material onto a substrate, and at least one first supply device (8) which is used to prepare and supply the coating material to the nozzle arrangement (1), in addition to at least one second supply device (9) which is used to prepare and supply the steam as auxiliary gas to the nozzle arrangement (1).

(Fig. 2)